

is respectfully requested. Applicants submit that these amendments are proper, even in view of the finality of the Office Action, because it is believed that these amendments place the application in condition for allowance.

Claims 21-23 and 25-53 are before the Examiner for consideration.

Rejections under 35 U.S.C. §102(e)/103(a) over Bai

Claims 21-23 and 40-45 have been rejected under 35 U.S.C. §102(e)/103(a) as being anticipated by, or obvious over, Bai (U.S. Patent 5,714,418). Claims 24-31, 48-50, 52, and 53 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Bai in view of Ho, Hower, and Fu. Claims 32-39 and 51 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Bai in view of Ho, Hower, and Fu. Claims 46-47 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Bai in view of Dixit.

Applicants respectfully traverse these rejections.

Applicants have amended independent Claim 21 to include an additional step in the claimed method. In particular, independent Claim 21 has been amended to include a step of plasma annealing the metal nitride layer. Applicants submit that Bai neither teaches nor suggests any sort of plasma treatment, including plasma annealing a metal nitride layer as presently claimed. As such, the presently claimed invention is not the same patentable invention claimed in Bai. Accordingly, Applicants respectfully request entry and full and favorable consideration of the Declaration under 37 C.F.R. §1.131 originally filed on October 18, 1999 to antedate Bai.

Applicants submit that the Declaration establishes that the inventors have both conceived of and reduced the claimed invention to practice before November 8, 1995, the earliest effective filing date of Bai. Thus, the Declaration under 37 C.F.R. §1.131 effectively “swears behind” the effective filing date of Bai and removes Bai as a prior art reference. Therefore, Bai, either alone or in

combination with secondary references, cannot anticipate or make obvious the presently claimed invention. Accordingly, Applicants respectfully request that these rejections be reconsidered and withdrawn.

Applicants take this opportunity to remind the Examiner that the law concerning the definition of “same invention” for the purposes of determining the scope of interfering claims was changed dramatically by the Board of Patent Appeals and Interferences in Winter v. Fujita. Indeed, a proposed rulemaking has been introduced, and comments offered, to change the C.F.R. to reflect this new precedent. Under the decision in Winter, claims of an application do not interfere with those of an issued patent unless the claims, without more, if considered prior art (in Liao’s claims are prior art with respect to Bai) would anticipate or render the claims of Bai obvious, and the claims of Bai, if taken as prior art with respect to the claims of Applicants herein (and they are not) would render those claims anticipated or obvious. While it may be that the claims of the above-captioned application would be sufficient to render those of Bai obvious, it is certainly not true, nor has the Examiner endeavored to demonstrate, that the claims of Bai would render the claims herein obvious. The Examiner continues to rely, not on the claims of Bai, but on the disclosure. See, e.g., page 3. This is inappropriate. In point of fact, the claims herein specifically require formation of a structure from a conductive surface, through a channel having interior walls above the conductive surface, features nowhere recited in the Bai claims. This, alone, is sufficient to distinguish the claims pending over the claims of Bai. Moreover, Bai requires a step not recited in the claims herein, the formation of a conductive layer directly on a blocking layer. The conductive layer is specified as to thickness and reactivity, again, restrictions that characterize Bai, but not the claims herein. Finally, as noted, none of the claims of Bai recite a plasma annealing step, a feature of the claims herein.

While the Examiner may believe that the claims of the patent and the claims of the pending application address the same fundamental problem, something Applicants disagree with, this, alone, is not sufficient to place the cases into interference. Should the Examiner elect to persist in this rejection, the Examiner is respectfully requested to indicate (a) how the claims of Bai render the claims of the pending application obvious, without referring to the specification, and (b) how the claims of the application render the claims of Bai obvious, without referring to the specification. In the absence of such analysis, the rejection cannot be maintained.

Rejections under 35 U.S.C. §103(a)

Claims 21-23 and 40-47 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Dixit or Sandhu in view of Suguro. Applicants respectfully traverse this rejection.

Applicants have amended independent Claim 21 to include an additional step in the claimed method that is not taught or suggested within the Examiner's cited references. More specifically, independent Claim 21 has been amended to include a step of plasma annealing the metal nitride layer. None of Dixit, Sandhu, or Suguro teach or suggest any kind of plasma treatment, including plasma annealing a metal nitride layer as presently claimed. This lack of teaching in the cited references is confirmed by the Examiner on page 8, lines 4-5 of the outstanding Office Action. As such, Applicants respectfully submit that Claim 21 and all claims dependent therefrom are non-obvious and patentable.

Further, Applicants respectfully submit that the Examiner's reliance on Suguro to overcome the fundamental teaching of the primary references away from the fundamental recitation of claims herein of a maximum thickness for the metal nitride layer of 130 Å cannot be cured by reliance on Suguro. Applicants completely agree that Suguro teaches a titanium nitride film of 10 nanometers in

thickness. But it teaches it for a reason entirely unrelated to the use of the metal nitride layer in Dixit. The 10 nanometer thickness selected in Suguro is selected to be “thick enough to suppress reactions and maintain adhesion”, Suguro, page 277, and do not discuss the problem with pinhole formation. Indeed, it is not clear that pinhole formation would negatively effect the surfaces in Suguro, as this is not assayed for. In contrast, Dixit contains a strong teaching away from the claimed invention, when describing nitride barrier layers for the very purpose recited in the claims herein, the formation of contact holes.

Sputter deposition of TiN is accomplished by sputtering Ti in an argon/nitrogen ambient. TiN can also be formed by titanium deposition followed by reactive annealing in a nitrogen ambient. It is difficult to form a pinhole-free barrier with thicknesses less than about 250 Å and employing thicknesses greater than about 2,000 Å provides little additional protection.

Dixit, column 4, lines 58-64. Applicants respectfully submit that such a strong teaching away, at the very point of invention, cannot be overcome by a general observation of the adequacy of thin layers for a different purpose in a different environment. If Suguro were sufficient to render the claim unpatentable, without more, the Examiner would so have relied on it. Since it fails to suggest the claimed invention, and references that do suggest the invention, generally, specifically teach away from a point of novelty of the claims, the combination of Dixit with Suguro to teach a thin layer of titanium nitride is offensive to 35 U.S.C. §103, and withdrawal of the rejection is respectfully requested. Again, for purposes of appeal, the Examiner is respectfully requested to provide a specific explanation of how one of ordinary skill in the art would rely on Suguro to overcome the specific teaching of Dixit to form minimum thicknesses of 250 Å.

Applicants respectfully submit that Claim 21, as amended, defines an invention that is not taught or suggested within Dixit, Sandhu, or Suguro. Accordingly, Applicants respectfully request

that Claim 21 be passed to allowance, together with all claims dependent therefrom.

Rejections under 35 U.S.C. §103(a) over Dixit or Sandhu in view of Suguro, Ho, Hower, and Fu

Claims 24-31, 48-50, 52 and 53 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Dixit or Sandhu in view of Suguro and further in view of Ho, Hower, and Fu. Claims 32-39 and 51 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Dixit or Sandhu in view of Suguro and further in view of Ho, Hower, and Fu. Applicants respectfully traverse these rejections.

Applicants submit that presently claimed invention is not the same patentable invention claimed in either Hower, Sandhu, or Fu. Accordingly, Applicants respectfully request entry and full and favorable consideration of the Declaration under 37 C.F.R. §1.131 originally filed on October 18, 1999.

Applicants submit that the support relied upon as a basis of the Declaration under 37 C.F.R. §1.131 originally filed on October 18, 1999 establishes that the inventors have both conceived of and reduced the claimed invention to practice before December 30, 1994, the earliest effective filing date of Hower. Although the Declaration under 37 C.F.R. §1.131 was submitted originally to overcome Bai and thus states that the present invention was conceived of and reduced to practice before November 8, 1995, the earliest effective filing date of Bai, Applicants submit that the present invention was actually conceived of and reduced to practice before December 30, 1994, the earliest effective filing date of Hower. Thus, the Declaration under 37 C.F.R. §1.131 effectively “swears behind” the effective filing date of Hower (December 30, 1994), Sandhu (July 31, 1995), and Fu (November 27, 1995) and removes Hower, Sandhu, and Fu as prior art references. Therefore, Hower, Sandhu, and Fu, either alone or in combination with other references, cannot anticipate or

make obvious the presently claimed invention.

With respect to Dixit, Applicants again submit that Dixit teaches away from the presently claimed invention. As stated in column 4, lines 55-57, “the barrier layer 20 is preferably formed to a thickness of about 250-2,000 Å”. Further, the reference states that “it is difficult to form a pinhole-free barrier with thicknesses less than about 250 Å”. (See column 4, lines 61-63). Thus, Dixit specifically teaches that thicknesses less than 250 Å creates pinholes, which is a negative feature in the field of integrated circuits.

According to case law, “there must be something present in the teachings of the reference to suggest the claimed invention to one of ordinary skill in the art.” (In re Bergel, 13 USPQ 206 (CCPA 1961) and In re Sponnoble, 160 USPQ 237 (CCPA 1969)). Dixit provides nothing in its teachings to suggest the presently claimed invention to one of ordinary skill in the art. In particular, there is no teaching or suggestion in Dixit for one of ordinary skill in the art to experiment with thicknesses of less than 250 Å because, according to the teachings of Dixit, thicknesses less than 250 Å effect an undesirable result. In fact, one of skill in the art reading Dixit would be led to experiment with thicknesses greater than 250 Å and would not arrive at the presently claimed invention by reading the disclosure of Dixit.

Additionally, without sufficient teaching or suggestion in a cited reference, there can be no motivation for one of skill in the art to arrive at the present invention. Dixit does not provide any teaching or suggestion of a thickness of less than 130 Å. Accordingly Dixit does not provide motivation for one of skill in the art to arrive at the presently claimed invention. Without motivation, there can be no case of obviousness.

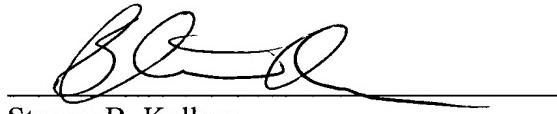
In view of the above, Applicants submit that the present invention is patentable over Dixit or Sandhu in view of Suguro and further in view of Ho, Hower, and Fu and respectfully request that these rejections be reconsidered and withdrawn.

CONCLUSION

In light of the above, Applicants believe that this application is now in condition for allowance and, therefore, request favorable consideration. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

Respectfully submitted,

PIPER MARBURY RUDNICK & WOLFE



Steven B. Kelber
Registration No: 30,073
Attorney of Record

1200 Nineteenth Street, N.W.
Washington, D.C. 20036
Telephone No: (202) 861-3900
Facsimile No: (202) 223-2085



SERIAL NO. 08/825,360

DOCKET NO.: 8543-004-27 CIP

MARKED-UP COPY OF AMENDED CLAIMS

21. (Amended) A method for forming a structure in an integrated circuit, said structure extending from a conductive surface through a channel having inner walls extending above said conductive surface, said method including the steps of:

(a) depositing a layer of a refractory metal on said conductive surface and said inner walls of said channel; [and]

(b) forming a layer of a metal nitride on said layer of said refractory metal, wherein said layer of said metal nitride has a thickness extending from said layer of said refractory metal of less than 130 Å; and

(c) plasma annealing said layer of metal nitride.

25. (Amended) The method of Claim [24] 21, wherein said step of plasma annealing includes the steps of:

exposing said metal nitride to an environment containing ions; and
electrically biasing said layer of said metal nitride to cause said ions from said environment to impact said metal nitride.

30. (Amended) The method of Claim [24] 21, wherein said step of depositing said metal nitride and said step of plasma annealing are both performed in a single chamber and without removing a wafer on which said structure is being formed from the chamber between beginning said step of depositing said metal nitride and completion of said step of plasma annealing.

31. (Amended) The method of Claim [24] 21, wherein said step of depositing said metal nitride is performed using chemical vapor deposition.

32. (Amended) The method of Claim [24] 21, wherein said step of plasma annealing includes the steps of:

performing a first plasma annealing of said metal nitride; and

performing a second plasma annealing of said metal nitride after performing said first plasma annealing.